

## REMARKS

This is intended as a full and complete response to the Office Action dated March 5, 2004, having a shortened statutory period for response set to expire on June 5, 2004. Claims 14 - 31 remain pending in the application and are shown above. Claims 14 - 31 stand rejected by the Examiner. Applicants present new claims 32-35 for consideration by the Examiner. Reconsideration of the rejected claims is requested for reasons presented below.

Claims 14-28, 30 and 31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of *Endo, et al.* '150, *Europe* '440, *Loboda, et al.*, newly cited, *Somekh* and *Zhao*. The Examiner has asserted that it would have been obvious of one of ordinary skill in the art to combine the teachings of *Endo et al.* ('150), *Europe* ('440) and *Loboda et al.*, with those of either one of *Somekh* and *Zhao*, to enable formation of the structure. Applicants respectfully respond to this rejection.

Applicant respectfully submit that *Somekh* (US Patent No. 6,291,334) and the pending application 09/270,039 are commonly owned by Applied Materials, Inc. Thus, *Somekh* is not prior art as asserted by the Examiner under U.S.C. §103(c). A statement of common ownership is submitted herewith.

Applicant discloses knowledge of the use of anti-reflective coatings (ARC) and photoresist materials in photolithographic processes for patterning a feature shape on a substrate surface and then etching the feature shape to form a feature definition. Applicants disclose knowledge that prior art anti-reflective coatings (ARC) have had high dielectric constants.

*Endo et al.* '150 discloses a process for depositing silicon carbide on a substrate. The substrate may be metallic, such as aluminum material. *Europe* '440 discloses depositing a silicon carbon barrier layer on a metal surface, between two metal layers to prevent interlayer diffusion, or between a metal and a subsequently deposited dielectric material to prevent diffusion of the metal into the dielectric material and insulate layers of wiring.

*Loboada et al.* discloses depositing a hydrogenated silicon oxycarbide film having low dielectric constant by reacting a methyl-containing silane in a controlled oxygen environment. *Loboada et al.* further discloses increasing or deleting oxygen providing gas at the appropriate time during the CVD process to form multilayer structures.

*Somekh* discloses depositing a carbon based etch stop, such as a diamond like amorphous carbon and fluorocarbon, or alternatively, silicon carbide, having a low dielectric constant in a method for forming a dual damascene structure. *Zhao* discloses depositing a etch stop over a low k dielectric layer, and the dielectric layer may comprise a variety of dielectric materials including silicon carbide.

*Endo et al.* provides no disclosure or suggestion of silicon carbide as a barrier layer, etch stop, or ARC, or depositing a silicon carbide layer with a low dielectric constant. *Endo et al.* further provides no disclosure or suggestion of depositing a first dielectric layer *in situ* on a silicon carbide layer or depositing a photoresist layer, wherein the first dielectric layer comprises a silicon-oxygen-carbon based material. Applicants also disclose that *Endo et al.* provides no disclosure of SiC as a barrier layer, etch stop, or ARC.

European Patent 0725440 does not disclose silicon carbide as an etch stop or anti-reflective coating as recited in one or more of the rejected claims. As disclosed in Applicants' specification, European Patent 0725440 (*Loboda* U.S. Pat. No. 5,818,071), is designed to accommodate a subtractive deposition in which the substrate deposition deposits the metal layer, then etches the metal and deposits the SiC into the etched metal layer. Therefore, routine optimization of the silicon carbide barrier layer of European Patent 0725440 in view of the other references as asserted by the Examiner would not suggest or motivate depositing a silicon carbide etch stop or a silicon carbide anti-reflective coating as recited in one or more of the rejected claims. European Patent 0725440 further provides no disclosure or suggestion of depositing a first dielectric layer *in situ* on a silicon carbide layer or depositing a photoresist layer, wherein the first dielectric layer comprises a silicon-oxygen-carbon based material.

*Loboada et al.* provides no disclosure for forming a first dielectric layer comprises a silicon-oxygen-carbon based material deposited from the plasma enhanced chemical vapor deposition of an organosiloxane, a disilano compound, or combinations thereof.

Further, *Loboada.*, *Somekh* and *Zhao*, either alone or in combination with any other references, does not teach, show, or suggest depositing silicon carbide materials, either *in situ*, or with other dielectric materials, wherein the dielectric layer comprises a silicon-oxygen-carbon based material first dielectric layer comprises a silicon-oxygen-carbon based material deposited from the plasma enhanced chemical vapor deposition of an organosiloxane, a disilano compound, or combinations thereof. Additionally, *Loboada et al.* does not teach, show, or suggest depositing silicon carbide materials as barrier layers, etch stops, or as ARC films.

*Endo et al.*, European Patent 0725440, *Loboada et al.*, *Somekh* and *Zhao*, and Applicants disclosure of knowledge, either alone or in combination, do not teach, show or suggest introducing silicon, carbon, and a noble gas into a chamber, initiating a plasma in the chamber, reacting the silicon and the carbon in the presence of the plasma to deposit a silicon carbide layer having a dielectric constant less than 7.0 on the substrate in the chamber, depositing a first dielectric layer *in situ* on the silicon carbide layer, wherein the first dielectric layer comprises a silicon-oxygen-carbon based material deposited from the plasma enhanced chemical vapor deposition of an organosiloxane, a disilano compound, or combinations thereof, and then depositing a photoresist layer, as recited in claim 14 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

*Endo et al.*, European Patent 0725440, *Loboada et al.*, *Somekh* and *Zhao*, and Applicants disclosure of knowledge, either alone or in combination, do not teach, show or suggest depositing a silicon carbide barrier layer on the substrate, depositing a first dielectric layer *in situ* on the barrier layer, wherein the first dielectric layer comprises a silicon-oxygen-carbon based material deposited from the plasma enhanced chemical vapor deposition of an organosiloxane, a disilano compound, or combinations thereof, depositing an etch stop *in situ* on the first dielectric layer, depositing a second dielectric layer *in situ* on the etch stop, depositing a silicon carbide anti-reflective coating *in situ* on the second dielectric layer, and depositing a photoresist layer on the silicon carbide

anti-reflective coating, as recited in claim 26, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claim 29 is rejected (claims 14-28, 30 and 31) rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of *Endo, et al.* '150, *Europe* '440, *Loboda et al.*, newly cited, *Somekh* and *Zhao* as applied to claims 14-28, 30 and 31 above and further in view of *Subrahmanyam, et al.* The Examiner asserts that it would have been within the scope of one of ordinary skill in the art to combine the teachings of *Endo et al.* '150, *Europe* '440, *Loboda et al.* '947, *Somekh* and *Zhao* and *Subrahmanyam et al.* to achieve reduction of contact resistance by including a nitrogen/hydrogen plasma cleaning.

*Endo et al.* '150, *Europe* '440, *Loboda et al.* '947, *Somekh* and *Zhao* are described above. *Subrahmanyam et al.* discloses a precleaning process for cleaning dielectric materials by a plasma of reactive gas such as oxygen, a mixture of  $\text{CF}_4/\text{O}_2$ , or a mixture of  $\text{He}/\text{NF}_3$ , with the plasma generated by a remote plasma source.

*Subrahmanyam et al.*, either alone or in combination with *Endo et al.* '150, *Europe* '440, *Loboda et al.* '947, *Somekh* and *Zhao*, does not teach, show or suggest introducing silicon, carbon, and a noble gas into a chamber, initiating a plasma in the chamber, reacting the silicon and the carbon in the presence of the plasma to deposit a silicon carbide layer having a dielectric constant less than 7.0 on the substrate in the chamber, depositing a first dielectric layer *in situ* on the silicon carbide layer, wherein the first dielectric layer comprises a silicon-oxygen-carbon based material deposited from the plasma enhanced chemical vapor deposition of an organosiloxane, a disilano compound, or combinations thereof, and then depositing a photoresist layer, as recited in claim 14 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

*Subrahmanyam et al.*, either alone or in combination with *Endo et al.* '150, *Europe* '440, *Loboda et al.* '947, *Somekh* and *Zhao*, does not teach, show or suggest depositing a silicon carbide barrier layer on the substrate, depositing a first dielectric layer *in situ* on the barrier layer, wherein the first dielectric layer comprises a silicon-oxygen-carbon based material deposited from the plasma enhanced chemical vapor deposition of an organosiloxane, a disilano compound, or combinations thereof, depositing an etch stop

*in situ* on the first dielectric layer, depositing a second dielectric layer *in situ* on the etch stop, depositing a silicon carbide anti-reflective coating *in situ* on the second dielectric layer, and depositing a photoresist layer on the silicon carbide anti-reflective coating, as recited in claim 26, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

The secondary references made of record are noted. However, it is believed that the secondary references are no more pertinent to the Applicant's disclosure than the primary references cited in the office action. Therefore, Applicant believes that a detailed discussion of the secondary references is not necessary for a full and complete response to this office action.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed. Having addressed all issues set out in the office action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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